CONNECTICUT DEPARTMENT OF TRANSPORTATION

DIGITAL DESIGN ENVIRONMENT GUIDE

CONNECT EDITION

Volume 15 – Miscellaneous Workflows

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Exercise 1 – Cross Sections for Import to HEC-RAS

This exercise will instruct users to create cross sections data using OpenRoads Designer (ORD) for import to the HEC-RAS software.

Skills Taught:

- Learn how to use ORD to create cross section data for import to HEC-RAS.
- Become familiar with the workflows and tools used in ORD for developing the required data for import to HEC_RAS.

Introduction:

OpenRoads Designers creates and uses information from the 3D surface models (Terrain) information. For most hydraulic designs, the survey terrain model (existing terrain) requested by the design lead unit will be adequate. If additional survey is needed this should be requested by H&D engineers from Surveys. In some instances, the highway design model or the bridge design model will also be needed to create a proposed terrain model. All terrains should be merged including the existing terrain into one terrain for best results of proposed conditions. For Help with merging terrains please see OpenRoads Designer CE - Help.

You will be using OpenRoads Designer tools and MicroStation tools to create the cross-section data for import to HEC_RAS.

Note: *This guide will not instruct you how to use HEC-RAS or how to manipulate the HEC-RAS data. For instruction on HEC-RAS please see Help within the HEC-RAS program.*

1.1 Create a New File

Before attempting to open or create DGN files users should make sure the following is in place:

- The CTDOT CONNECT DDE is synced through SharePoint
- The COMPASS Project is synced through COMPASS (SharePoint)

1. Launch the Application.
   - **Consultants -** via the appropriate **CTDOT DDE icon**
   - **CTDOT employees -** On your desktop double click on the **CAD Accounting icon**
2. After launching the program, a Welcome Screen will appear. Ensure you are using the **Custom Configuration** and **CT_WorkSpace**, then select the relevant **WorkSet** and **Role**. similar.

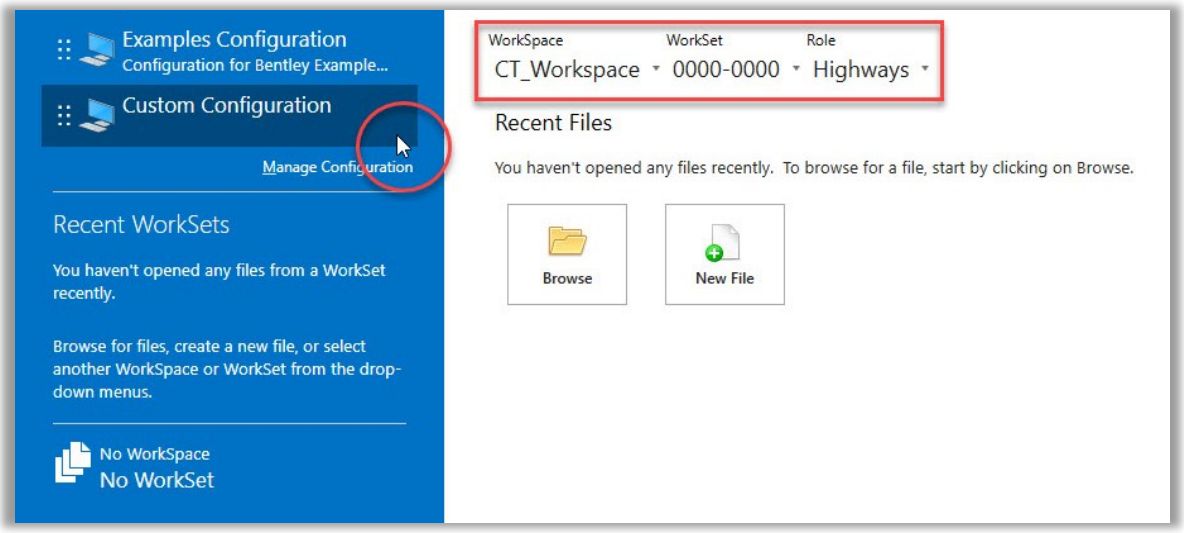

Figure 1 OpenBridge Modeler Splash Screen

If you do not see the Project Number listed, please request a Compass/CAD Setup using this link [New CAD Project Request]

3. Browse to open a **New File**. Browse to ***…|Hydro|Base_Models|***
4. Name your file, the file name should follow the Civil Design CAD File Naming Conventions:
    - Discipline Designator (HD for Hydraulics and Drainage)
    - Data Category (NC)
    - Project Number (1234_1234)
    - Description (HEC_RAS_MDL)

    File Name should read: ***HD_NC_1234-1234_HEC-RAS_MDL.dgn***

5. On the New dialog box click the **Browse** button to select the proper seed file.

   ...|CT_Configuration|Organization|Seed|Road|Seed2D – CT RoadDesign.dgn

6. Click on **Save** and the file will open.

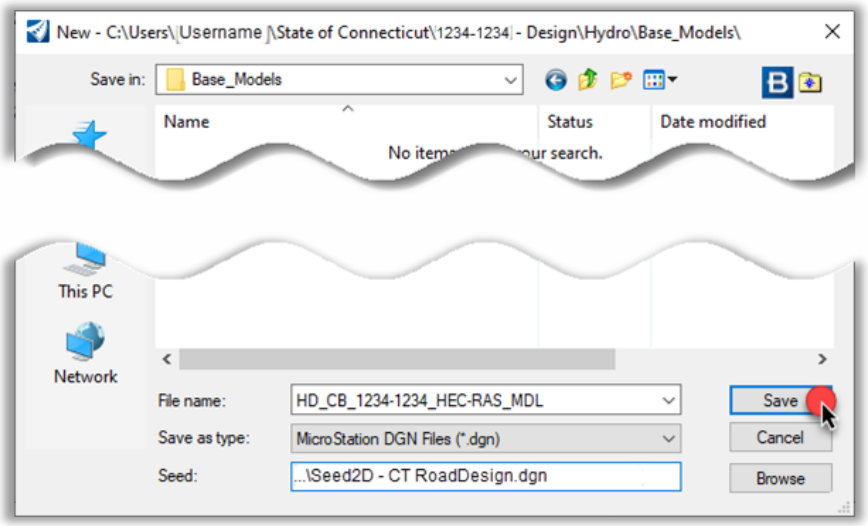

Figure 2 Create File

7. After the DGN file is created open File Explorer and browse to the file, **right click** and select **View online**.

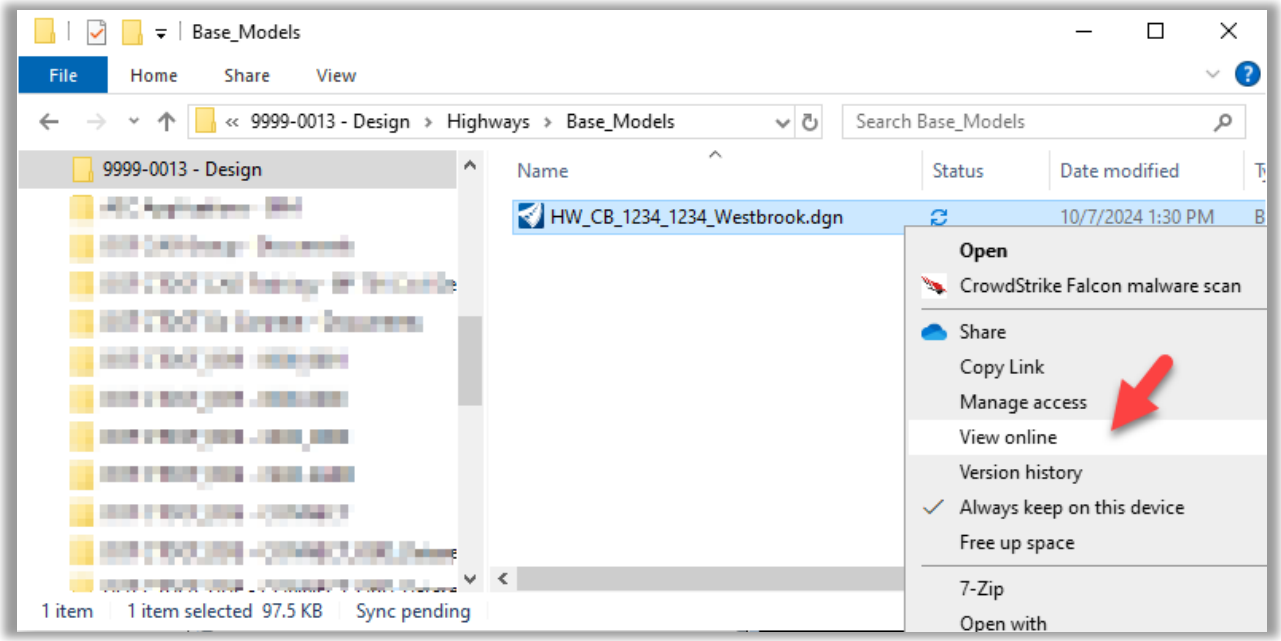

Figure 3 File Explorer View online tool

8. The Projects SharePoint site will open, sort by **Date**, click on the **three dots**, select ***More > Check Out***

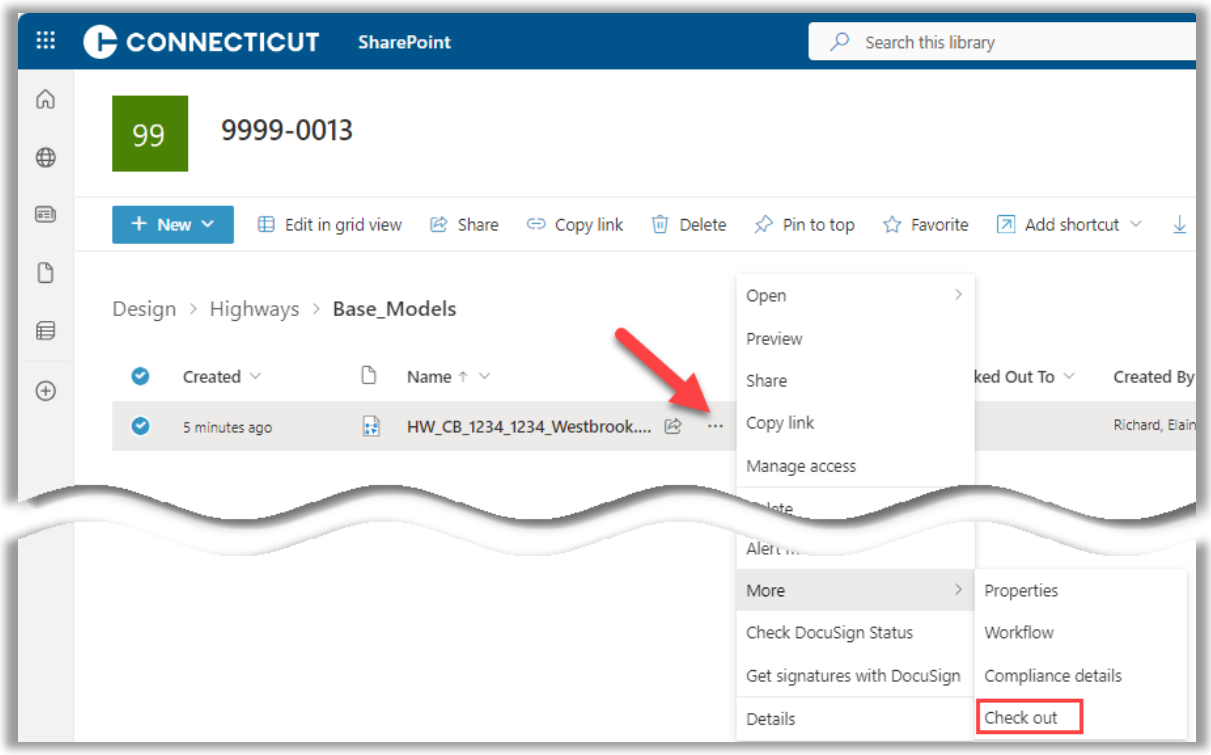

Figure 4 SharePoint Check out

9. Select the **OpenRoads Modeling** workflow from the workflow drop-down.
10. Select from the **Home** tab, **Primary** group, **Attach Tools > References**. Click on the **Attach References** tool and reference in the survey file (this should also contain the terrain model) from the ***Active_Survey*** folder. With older surveys you may need to reference in the terrain also.
11. Make the terrain **Active.**

Figure 5 Set Terrain Active

12. If the contours are not shown, click on the Properties icon to activate Properties box.
13. Set the **Override Symbology** to ***Yes***, this allows you to turn the Major and Minor Contours to On or Off, as well as Triangles, Flow Arrows, Breaklines etc.

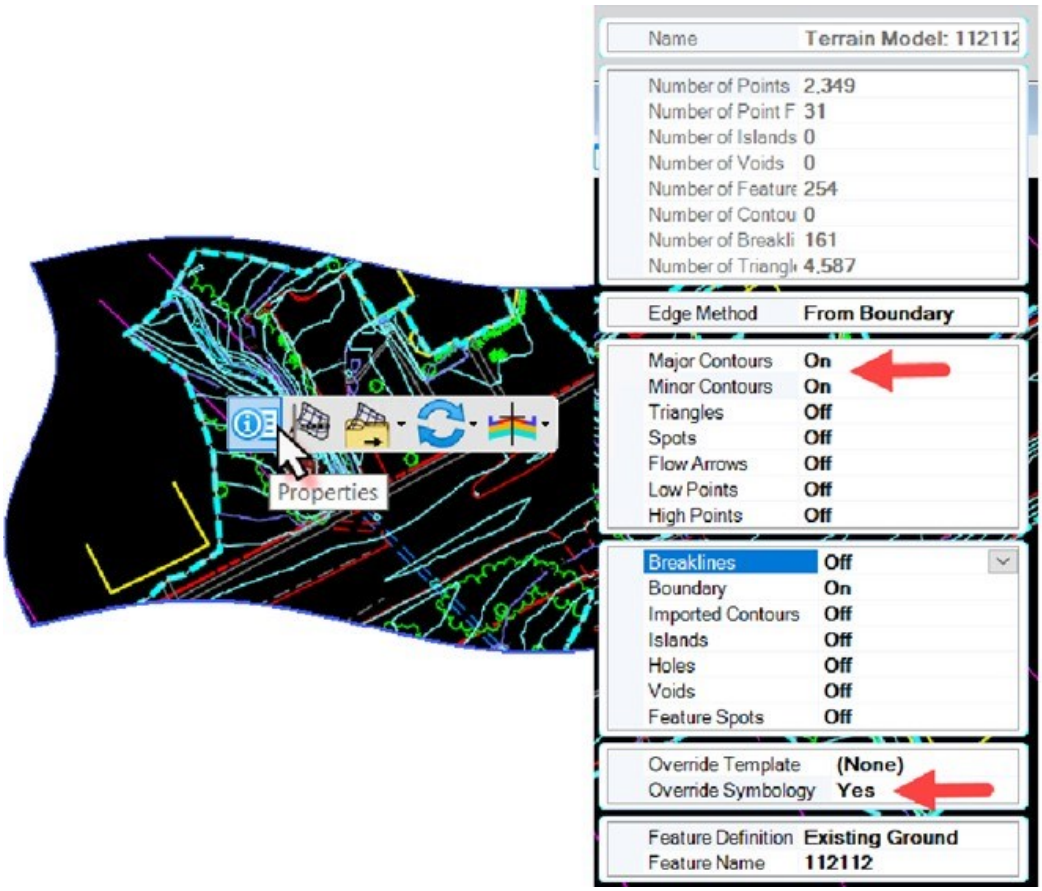

Figure 6 Turn on Contours

1.2 Create Stream Centerline

Next the user will use the Geometry tools to create the Stream Centerline going from downstream to upstream.

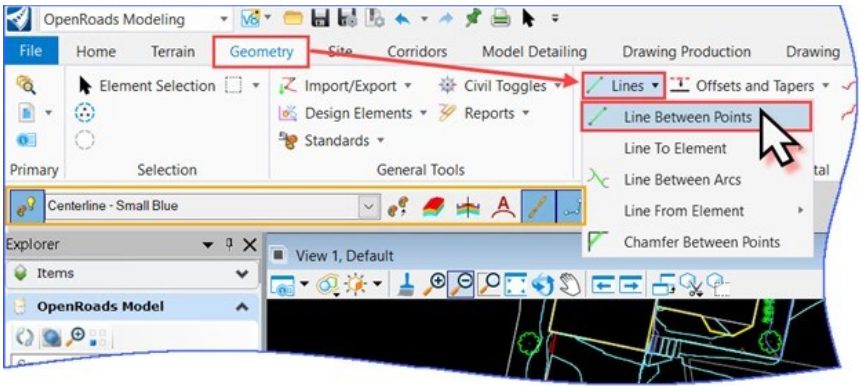

Figure 7

1. Click on the **Geometry** tab, **Horizontal** group, **Lines > Line Between Points.**
2. In the Line toolbox, select the Feature Definition: ***Centerline – Green***, Name leave: ***CL***

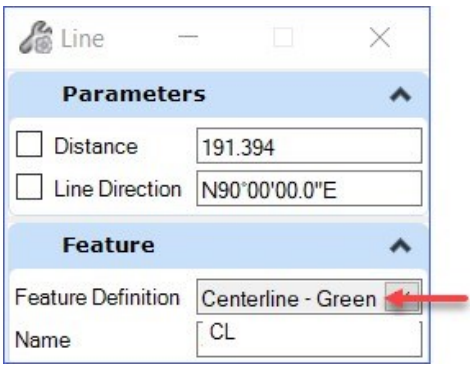

Figure 8

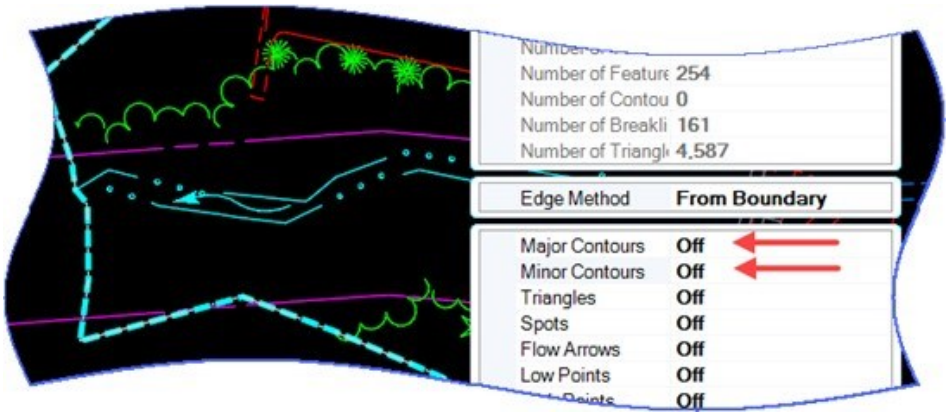

Figure 9

Note: *Open the Feature Definition Toolbar (***Geometry** tab, **General Tools** group, **Standards > Feature Definition Toolbar***) activate the Use Active Feature Definition toggle, select the feature definition and toggle on the Chain Commands (this will make it easier to draw the centerline of the stream).*

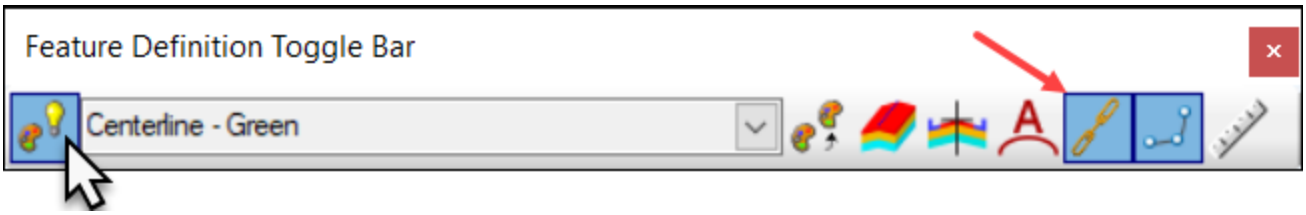

Figure 10 Feature Definition Toolbar

3. ***Enter the Start Point:*** click to the center of the stream (downstream) as the starting point of the stream centerline. Move the cursor upstream to the next location of the stream, doing so until the end of the stream or where cross sections are no longer needed. ***Right-Click*** when at the end. Select the Element Selection tool to get totally out of the command completely.

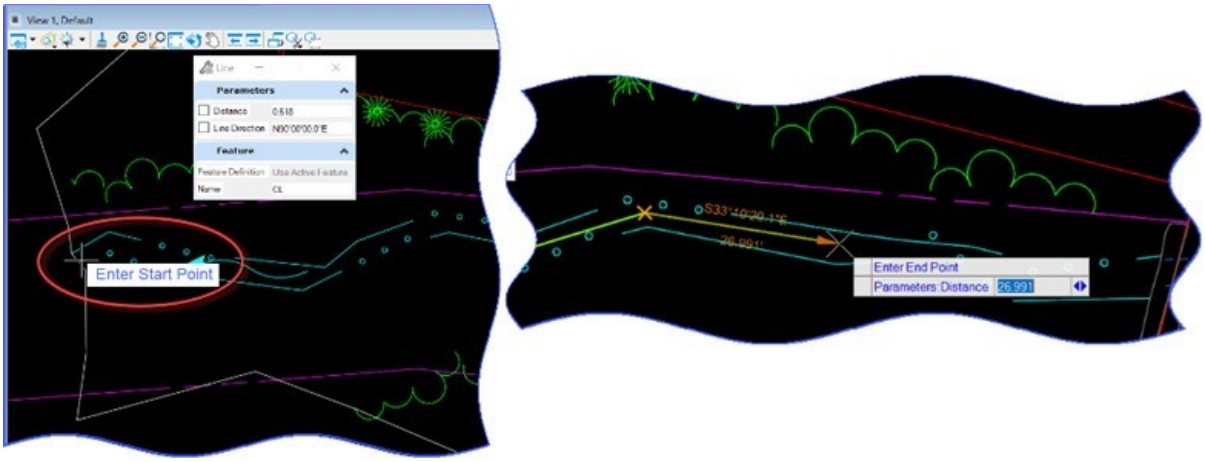

Figure 11 Enter Start Point

4. Next, the individual lines will need to be complexed. Still in the ***Geometry*** *Tab* **›** ***Horizontal*** *Group***›** click on the small down arrow for ***Complex Geometry*** and select ***Complex By Element*****.**

   Set the Complex Geometry toolbox to:

   - Method: Automatic,
   - Maximum Gap: 0.033,
   - Feature Definition: Centerline – Green (if not using the Feature Definition toolbar) Name: CL-Stream (or to the stream name).

5. Click to the first line just placed, see the highlighted arrow pointing upstream (click closer to the start to move the arrow into the right direction). When all lines are automatically highlighted, click to **Accept.** The centerline of the stream is now complete.

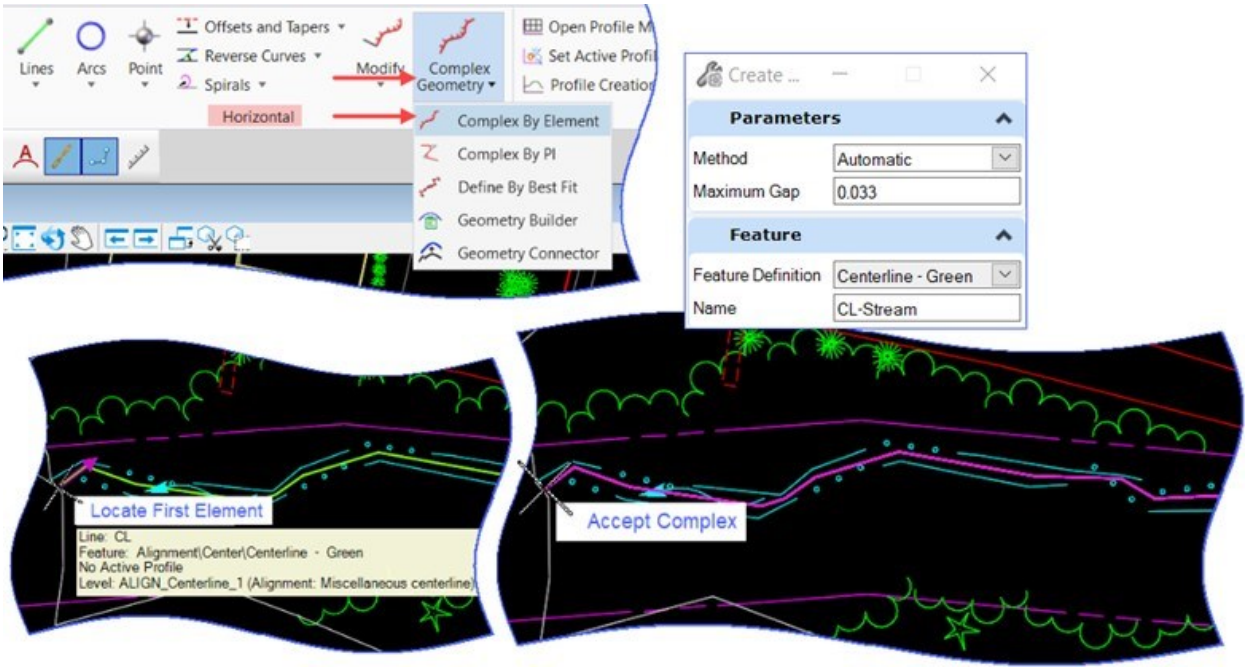

Figure 12 Locate and Accept

6. To show stationing for the stream centerline, follow these steps: ***Geometry*** *Tab* ***› Horizontal*** *Group* ***› Modify › Start Station.***

   Command Prompts (Head-up Prompts):

   Locate Element: tentative snap to the beginning of the Stream CL and left-click to **Accept.** The next prompts are:

   - Start Station Position: 0.000. **Accept**
   - Enter Starting Station: 100+00 (desired starting station) **Accept.**

   Select the ***Element Selection*** tool, click on the centerline, the beginning of the alignment should now read the beginning stationing, example 100+00.00.

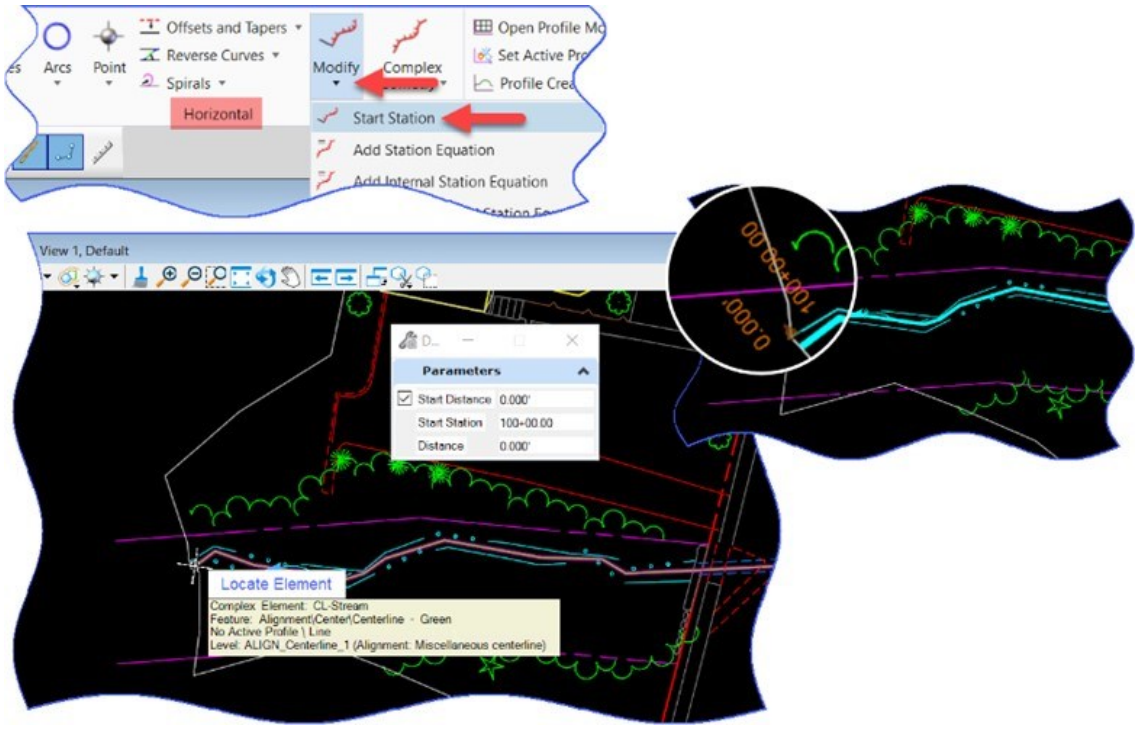

Figure 13 Select Start Station

6. The alignment can be annotated by clicking on the ***Drawing Production*** *Tab* ***>Annotation*** *Group* ***> Element Annotation > Annotate Element*** and ***click*** on the alignment.

   Stationing will show with stationing, PC and PT stations, bearings on, turn off levels as needed to just show the Stationing.

   Note: *Stationing is depending on the feature definition for the centerline. The Centerline – Green alignment will have stationing every 50 feet, with the full stationing showing at 100 feet. Centerline – Small Blue will have stationing every five feet and full stationing showing at 10 feet. Pick the stationing that best fits your need.*

1.3 Draw Bank and Overbank

1. Turn ON the major and minor contours if turned OFF.
2. Next the bank and overbank lines need to be drawn, for this MicroStation Drawing tools will be used.
3. Change the Active Workflow from OpenRoads Modeling to ***CTDOT*** and click on the ***Home*** tab.
4. From the ***Attributes*** group, click on the down arrow within the Active Level.
5. Next click on the ***Filters…,*** select:
6. ***"_Hydraulics [CTDOT_Tools_Levels_ElemTemp_Text_Dim_Favorites]"*** Filter
7. Click **OK.**
8. From the Hydraulics levels:

   WATER_L_Chnl_Bnk (Water Courses: Left Channel Bank) for the Left Bank and Left Overbank or

   WATER_R_Chnl_Bnk (Water Courses: Right Channel Bank) for the Right Bank and Right Overbank.
9. ***Double-click*** on either of the levels to make one of them active, example: ***WATER_L_Chnl_Bnk.***

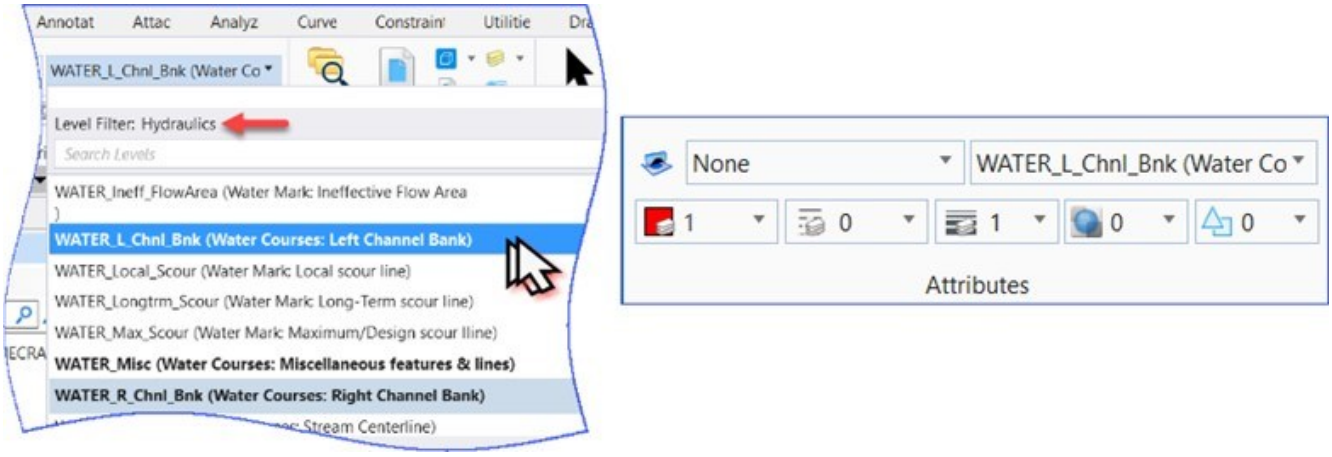

Figure 14 Select Level

10. Select the ***Place SmartLine*** command from the "Placement" tools,

11. Turn ***ON***: Join Elements, Rotate AccuDraw and Start in line mode.

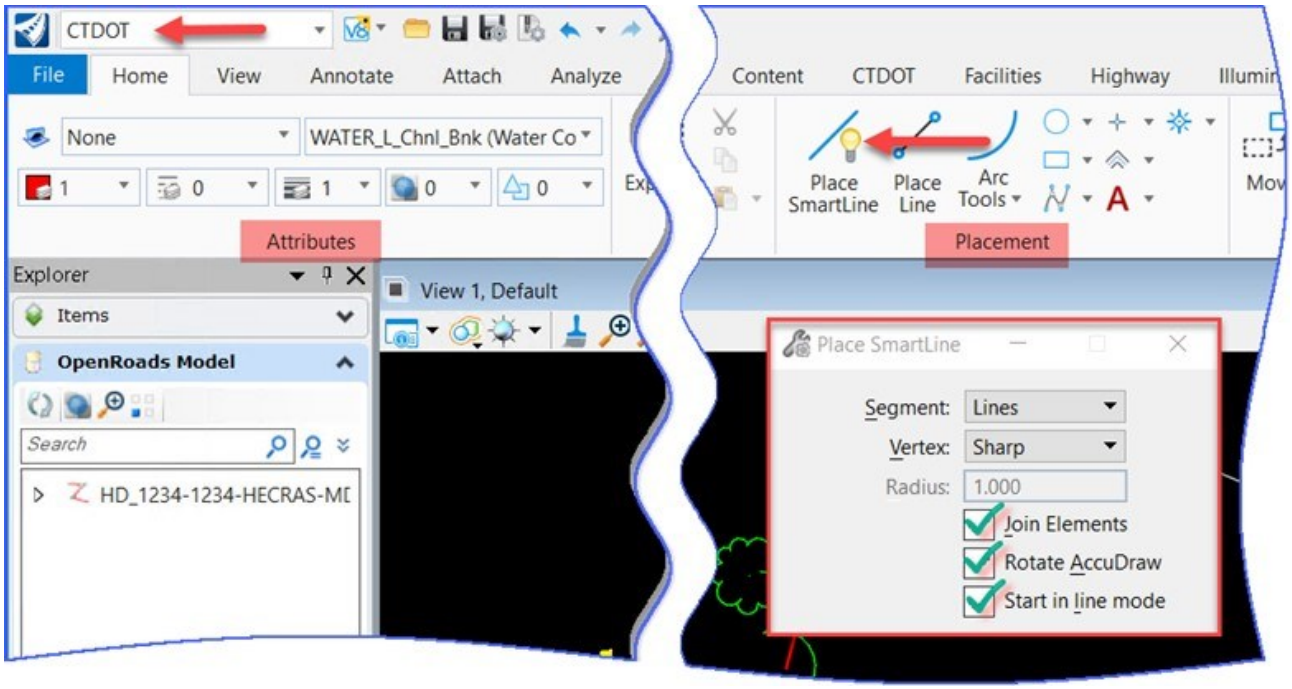

Figure 15 Place Smart Line

12. Starting downstream going upstream, place a continuous line for the left channel bank - **left-click** where the channel bank line is. Repeat for the left channel overbank.

13. Now **double-click** on the opposite level, example: ***WATER_R_Chnl_Bnk*** and repeat both steps, first draw a Smartline from downstream to upstream for the bank and then for the overbank.

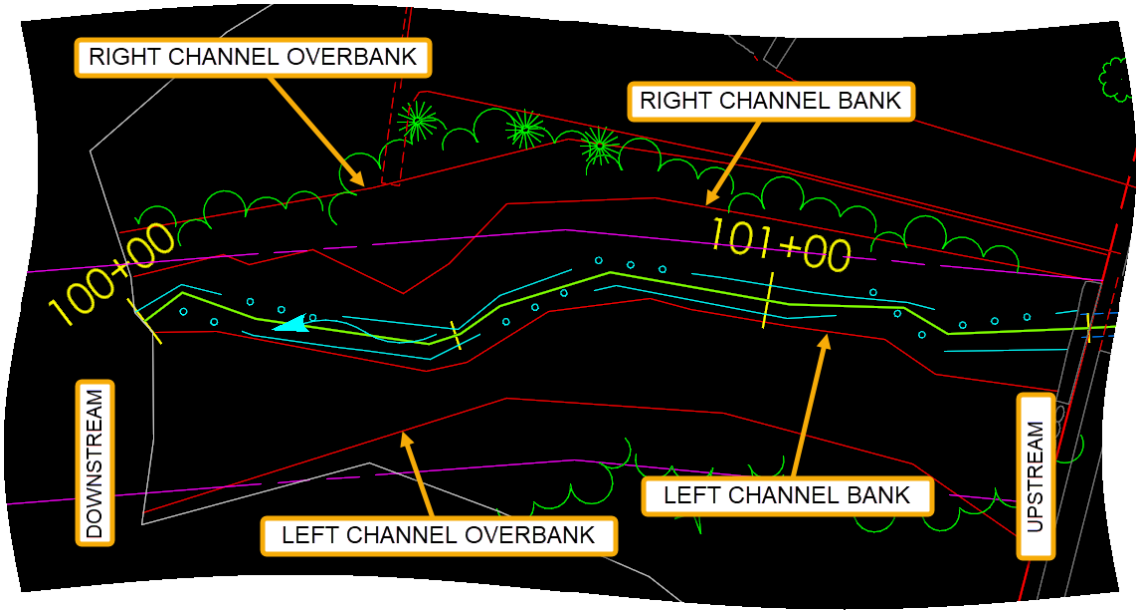

Figure 16 Bank and Stream Lines

1.4 Draw Cross Section Lines

1. Turn ***OFF*** the display of the survey reference file, to see the stream and bank lines better.
2. Change the level to **WATER_Misc (Water Courses: Miscellaneous features & lines).**
3. Use the ***Place SmartLine*** command to place cross section lines where you want cross sections to be created for HEC_RAS import.

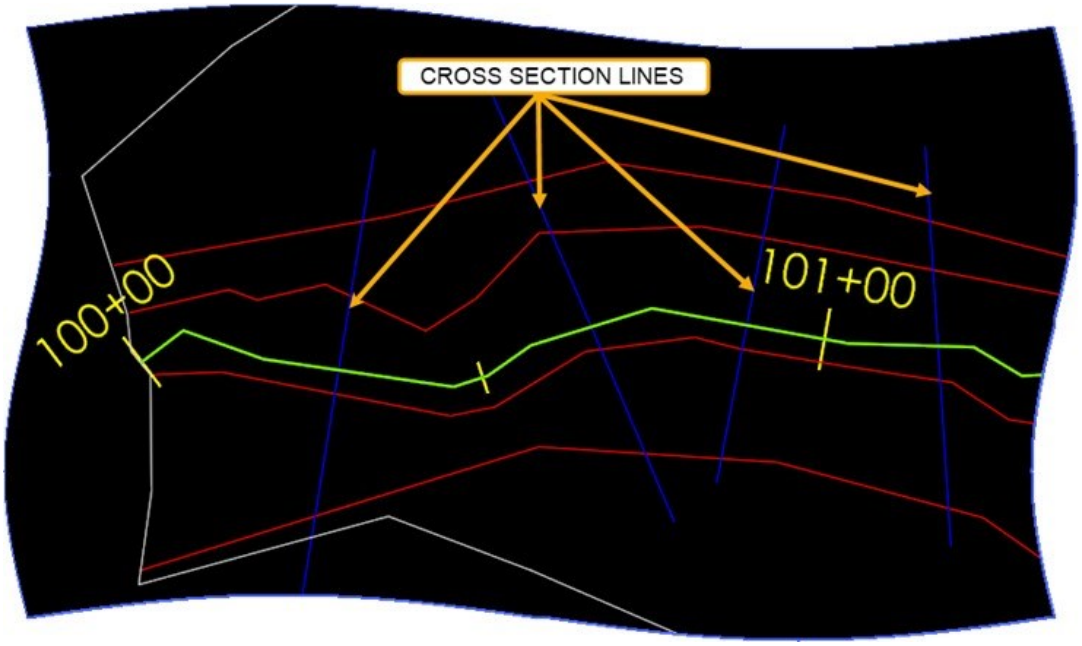

Figure 17 Cross Section Lines

Important Note: *It is vital to draw the lines from left bank to right bank for the import to HEC_RAS to work. This may not be necessary in later versions of ORD (current version: OpenRoads Designer CONNECT Edition – 2021 Release 2 – Version 10.10.21.04).*

4. When finished select the ***Element Selection*** tool. You can use this to make adjustments to the lines as needed.
5. Note: Even though the Stream-CL and banks are drawn from downstream to upstream, the Hydraulic sections are always oriented looking downstream.

1.5 Use Analysis Hydraulic Tool to Create HEC-RAS data

1. Next go back to the ***OpenRoads Modeling*** Workflow, select the ***Terrain*** tab, and locate the ***Analysis*** group. There click on the down arrow for the ***Hydraulic tools*** and select the ***Create HEC_RAS Data.***

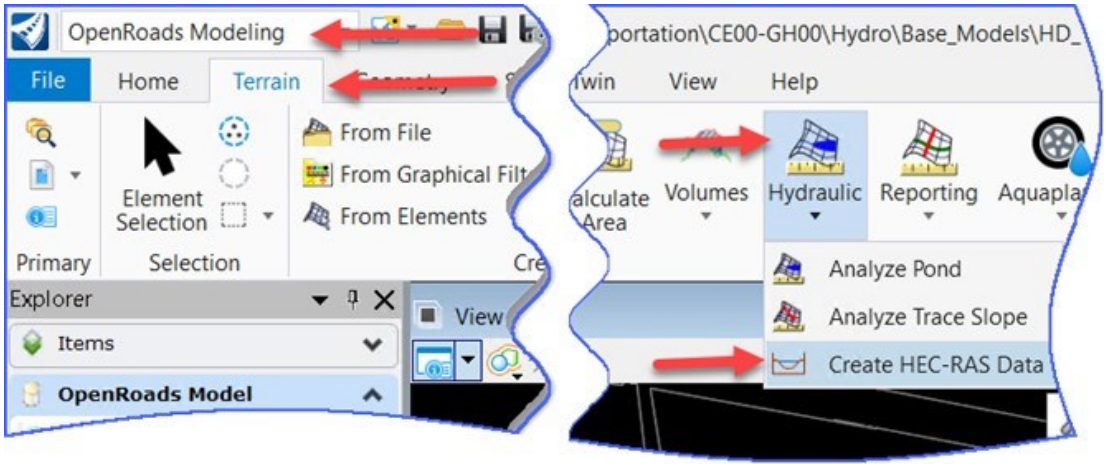

Figure 18 Hydraulic tools

2. Follow the command prompts or the heads-up prompts.

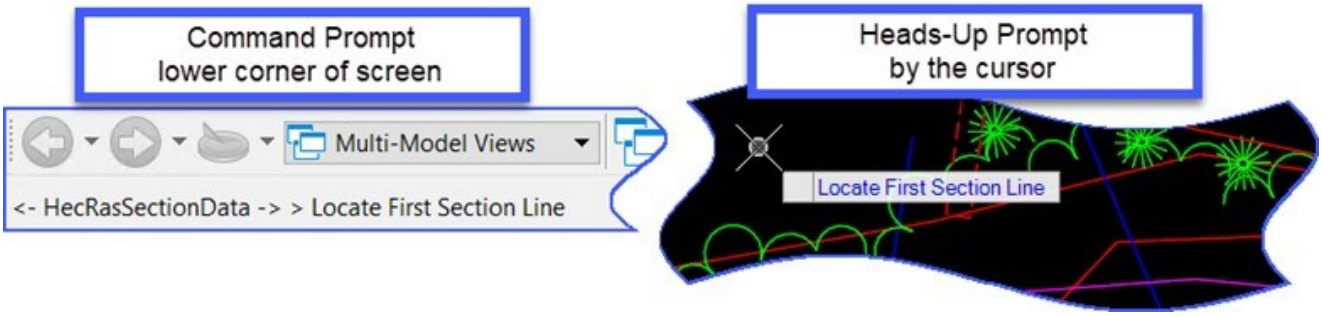

Figure 19 Locate First Line

3. ***Locate First Section Line***, **left-click** on the first cross section line;
4. ***Locate Next Section Line – Reset To Complete***, **left-click** on the next line and so on until the last line is selected (in example a total of 4 cross section lines) then **right-click** to complete the selection (Reset to Complete).

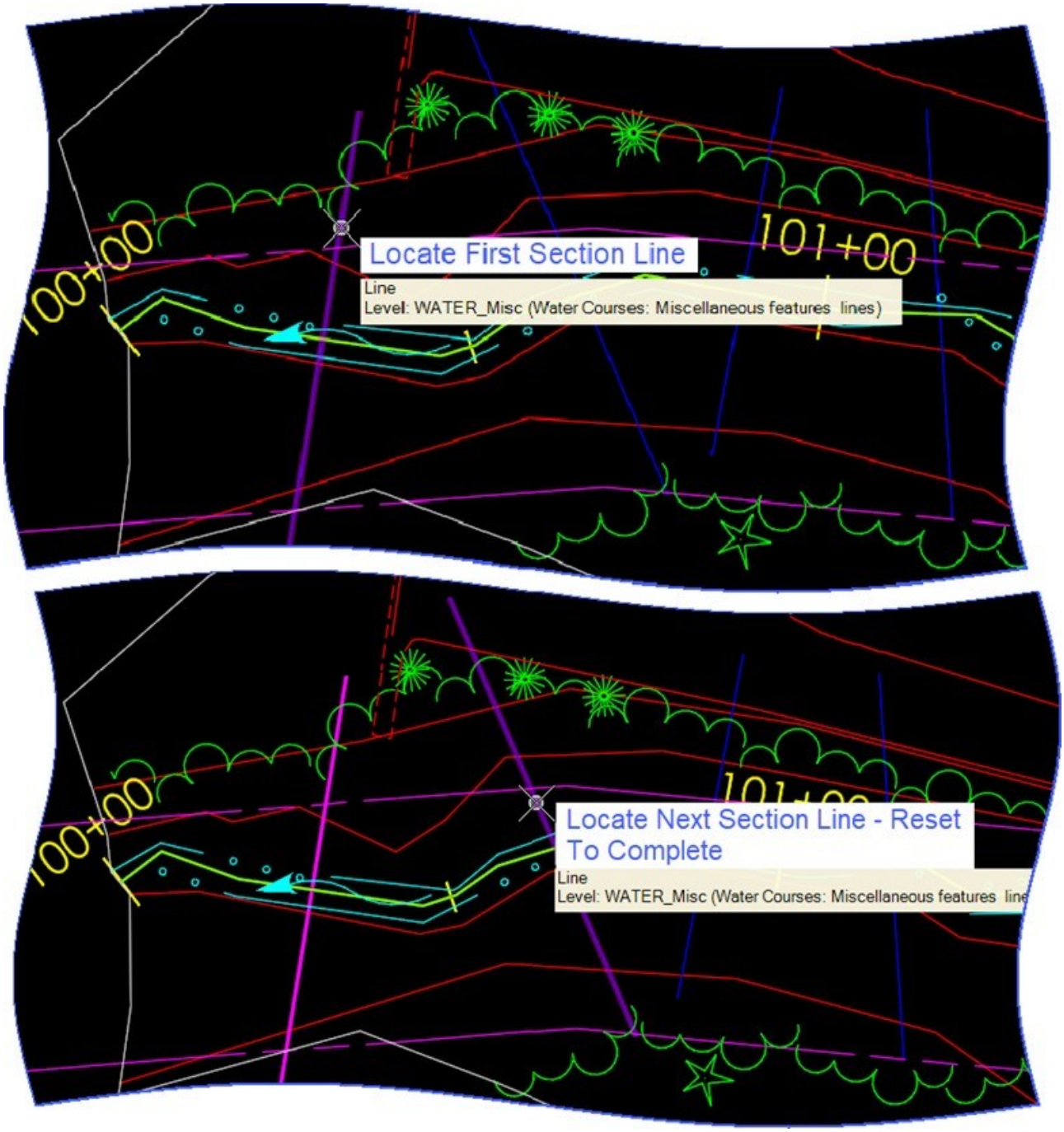

Figure 20 Select Line

5. ***Select Terrain Or Reset To Use Active Terrain***. Either select the terrain or right-click to use the active terrain.

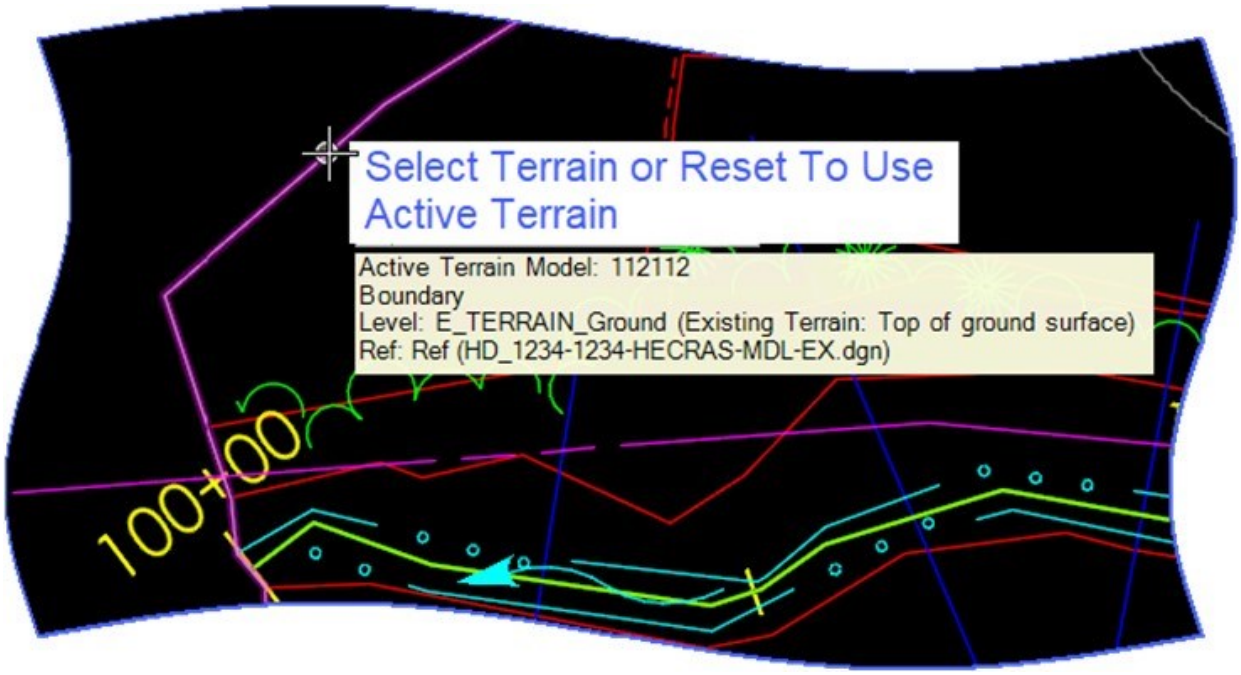

Figure 21 Select Terrain

6. **Locate Reference Line** – select the ***CL Stream*** alignment created in previous steps.

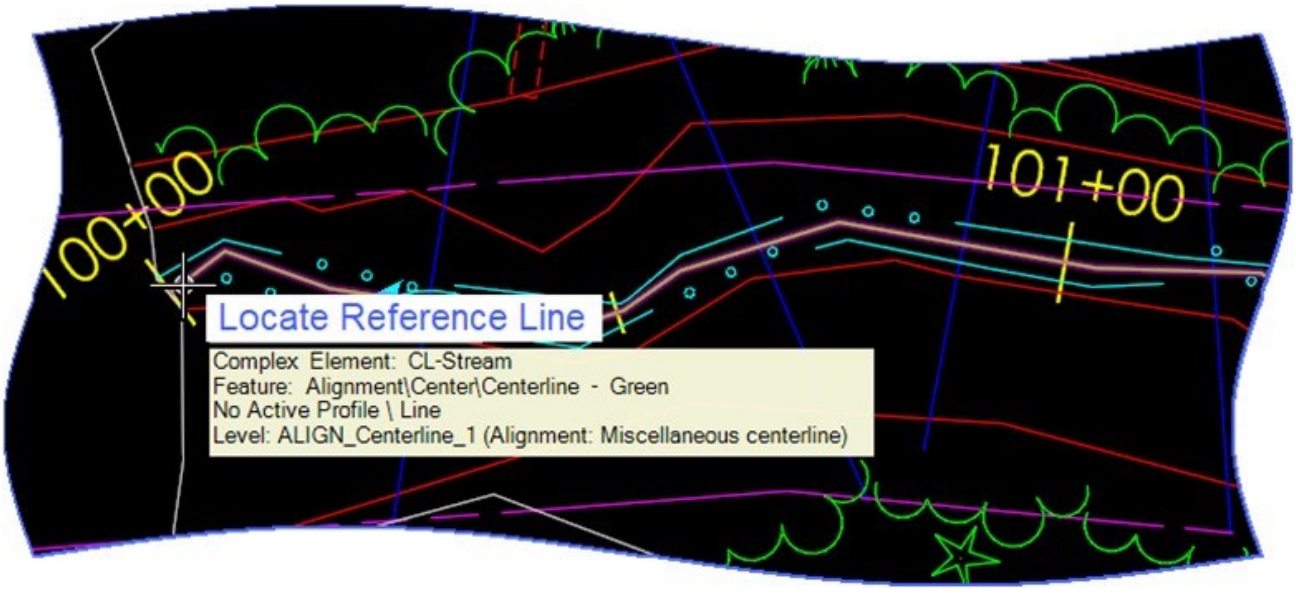

Figure 22 Locate Reference Lines

7. Next the left channel overbank and channel bank will be selected, then the right channel bank and channel overbank.
8. **Locate Left Bank Over** – select the left channel overbank,
9. **Locate Left Bank** – select the left channel bank,

10. ***Locate Right Bank*** – select the right channel bank and
11. **Locate Right Bank Over** – select the right channel overbank.

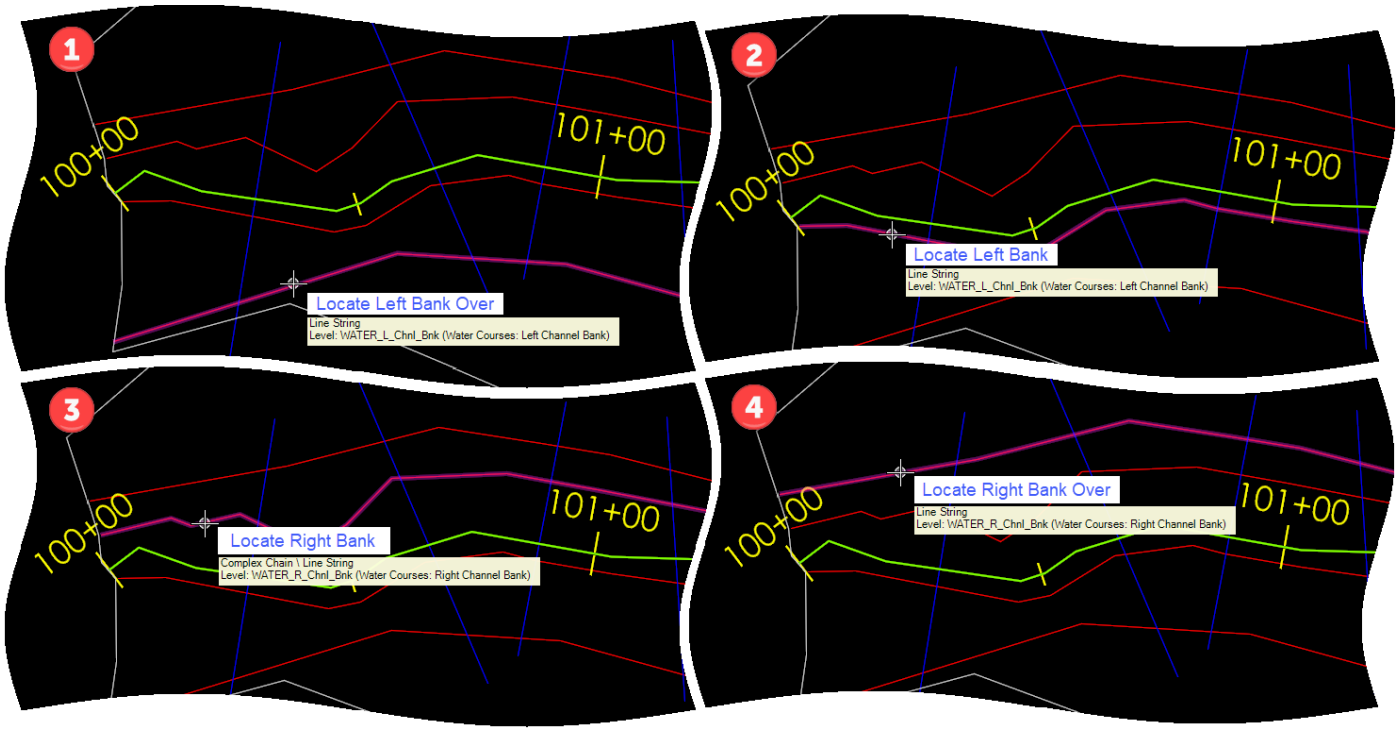

Figure 23 Locate banks

12. After you select the right channel overbank, the ***Create HEC-RAS Data menu*** comes up. Select the ***…\1234-1234 - Design\Hydro\Eng_Data*** folder and **Save** the file.
13. ***Note:*** *ORD will automatically name the file, you can edit as needed.*

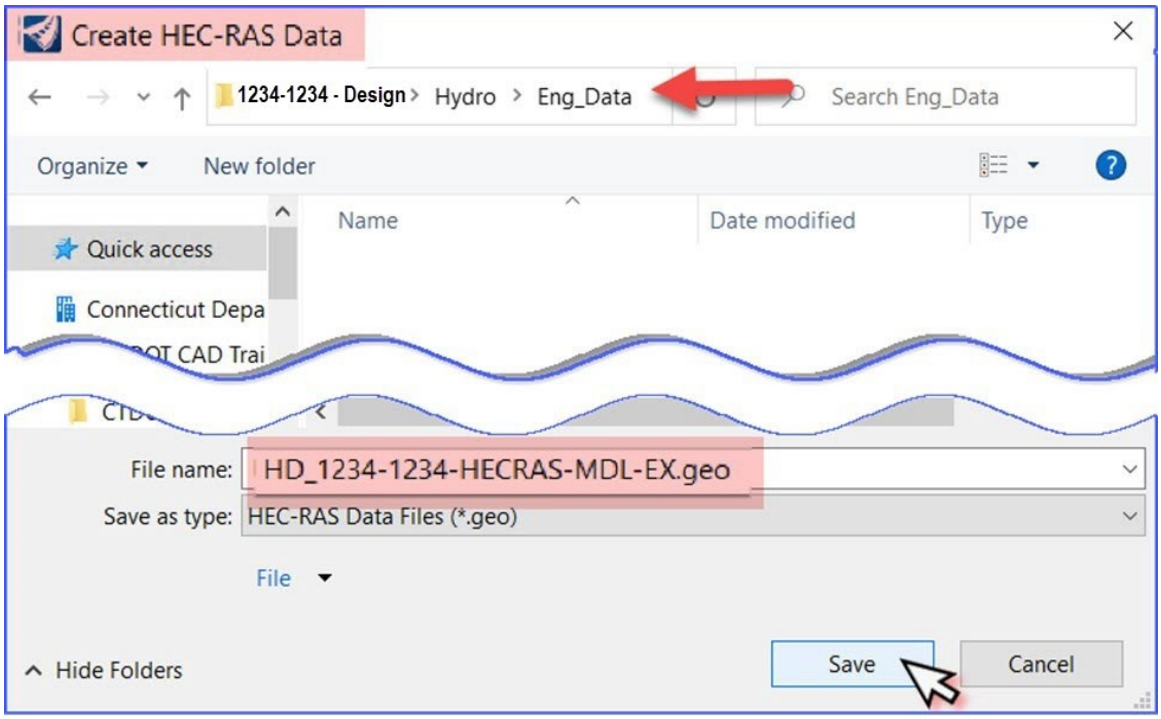

Figure 24 Create HEC-RAS Data

14. This completes the steps in OpenRoads Designer. You can **Close ORD** if you want.

1.6 Import OpenRoads Data to HEC_RAS

1. It will probably be more efficient to edit channel banks and River Station names within HEC_RAS rather than rerunning the OpenRoads workflow. Use the ***File Explorer*** to create a ***New Folder*** for the HEC_RAS data files:

   …\1234-1234 - Design\Hydro\Eng_Data\HEC_RAS_DATA

2. Open HEC-RAS from your desktop, ***Double-Click*** on the icon to open HEC_RAS.

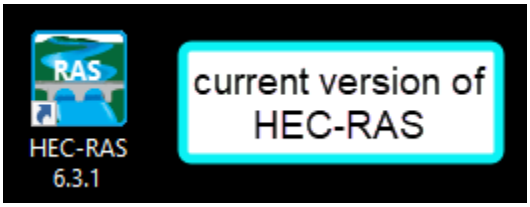

Figure 25 HEC-RAS icon

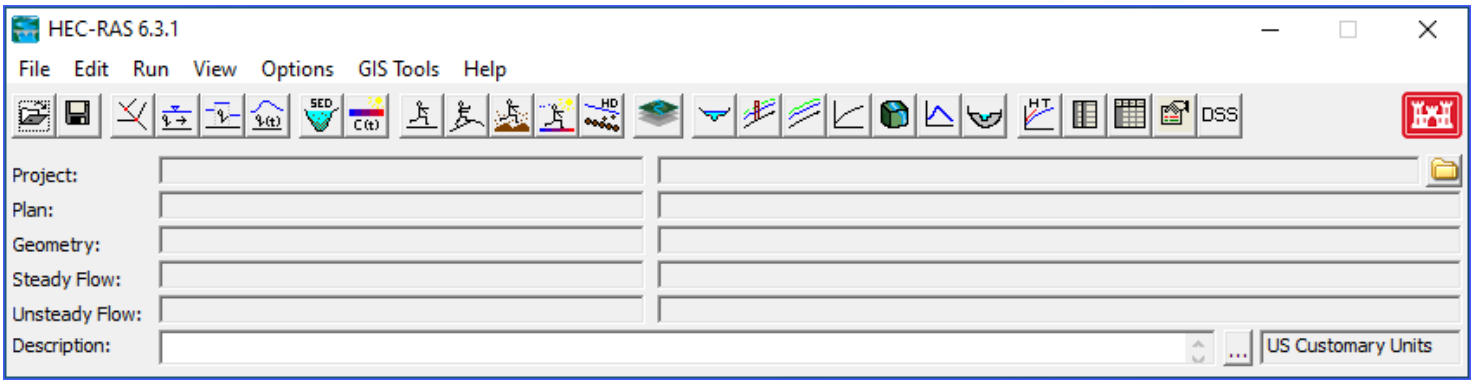

Figure 26 HEC RAS Dialog Box

3. Click on ***File > New Project***. Type in a logical name as Title, example:

   HD_1234_1234_HEC-RAS

   this populates the File Name box with the project extension, example:

   HD_1234_1234_HEC-RAS.prj.

4. Browse to your project directory's HEC-RAS folder. Change the drive location to your project file location:

   …\1234-1234 - Design\Hydro\Eng_Data.

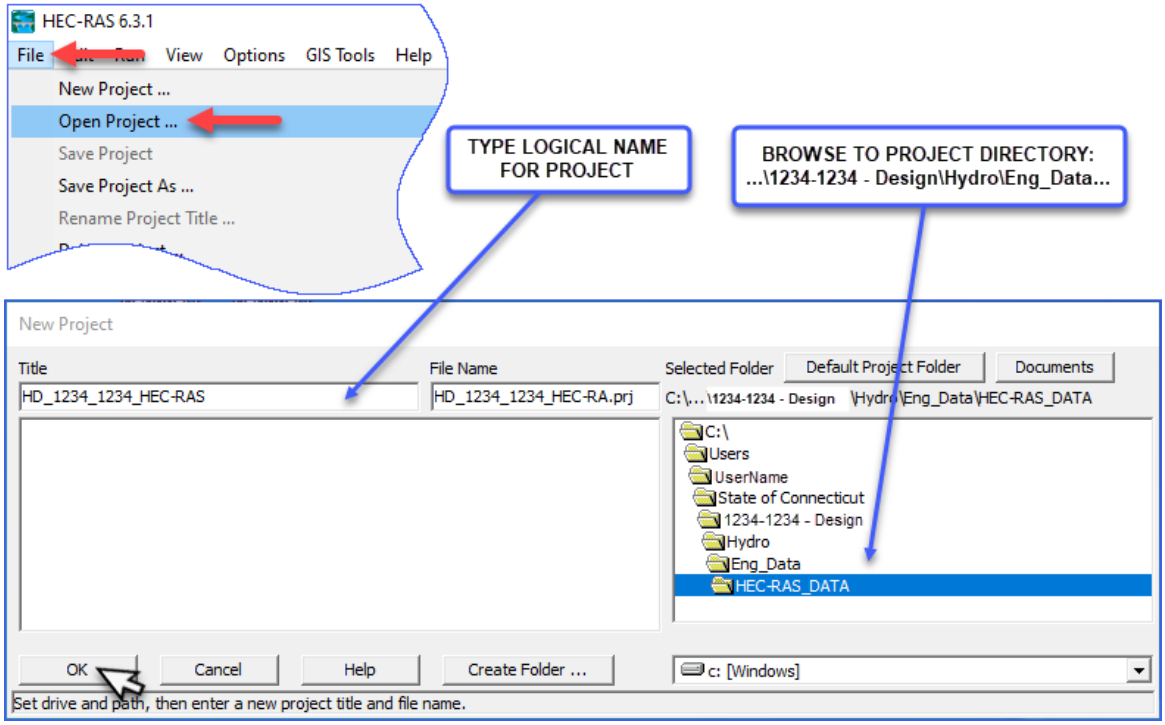

Figure 27

5. Click **OK** to create the project and folder.
6. A warning message may come up:

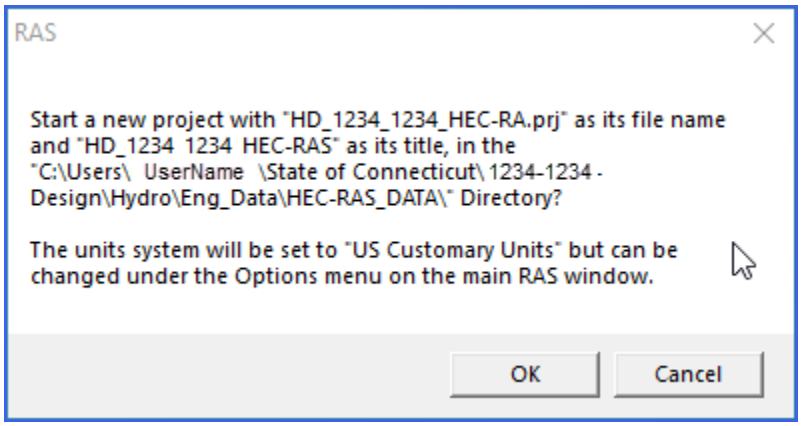

Figure 28

7. Click **OK**.
8. Click on ***View/Edit Geometric Data*** *(OR click on* ***Edit > Geometric Data)***, a new box opens: **Geometric Data**

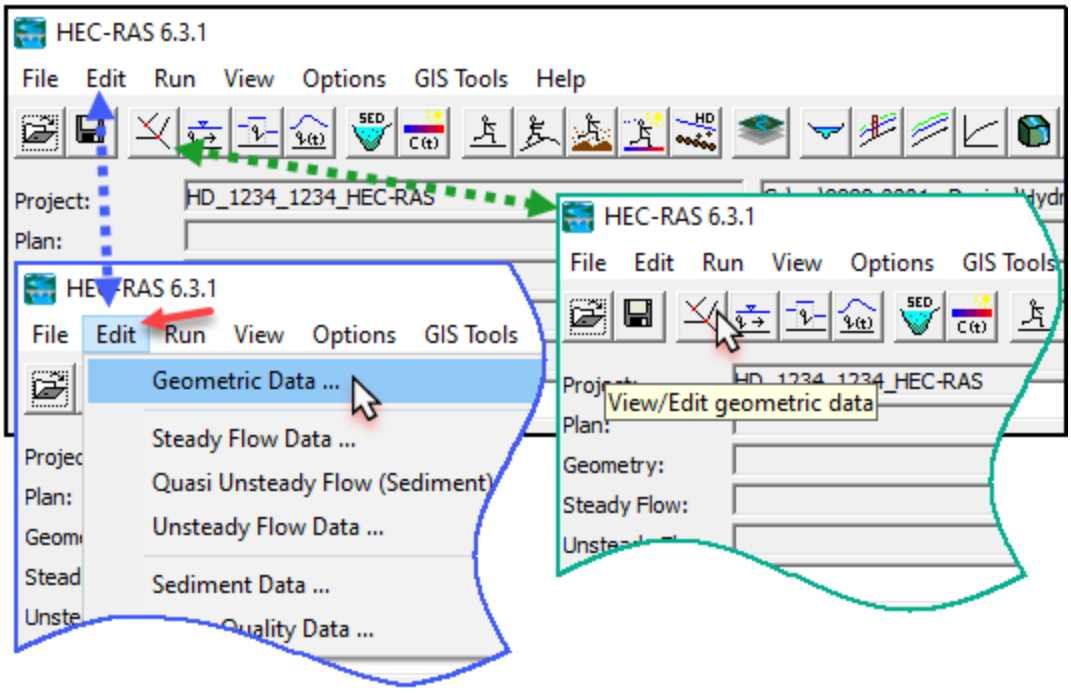

Figure 29

9. Click on ***File > Import Geometric Data > GIS Format***

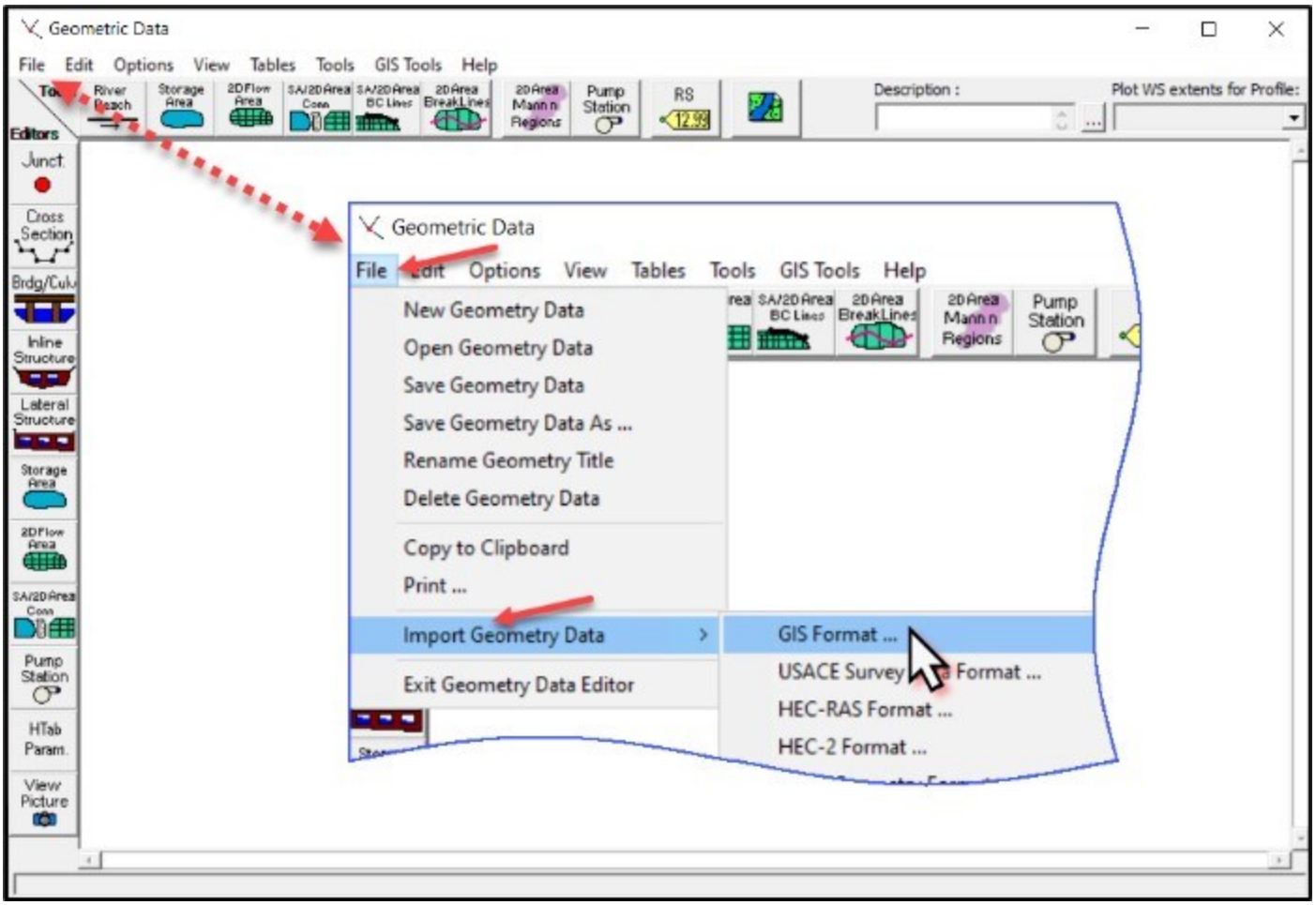

Figure 30

10. Browse to the ORD.geo file created using ORD Hydraulic tools, example:
11. ***HD_1234-1234-HEC-RAS-MDL-EX.ego***.
12. Click **OK**. The ***Import Geometric Data*** box opens.

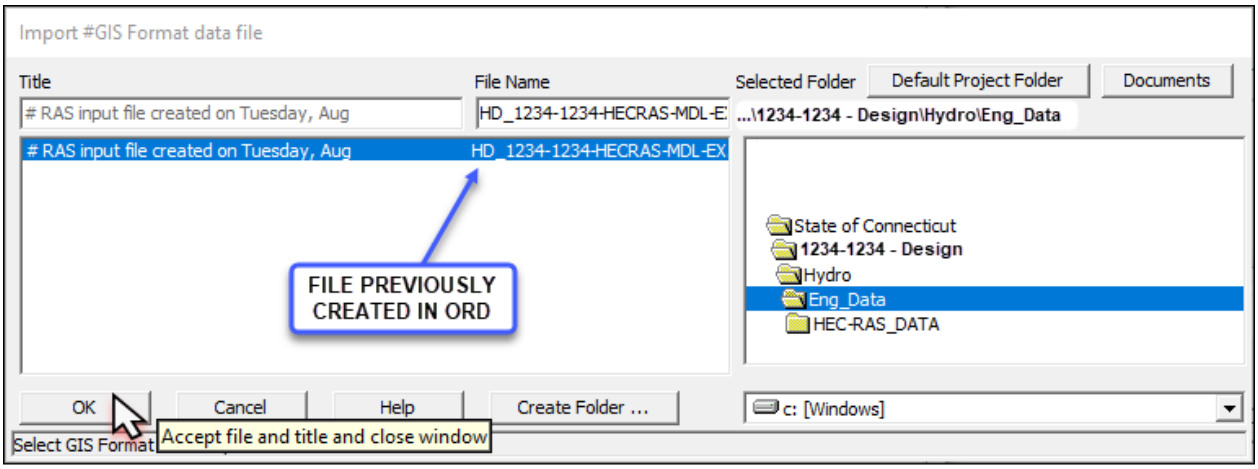

Figure 31

13. Make sure Import data as is set to: ***ON*** for US Customary units. You can step through the ***NEXT*** buttons and/or you can Click On: **Finished - Import Data**.

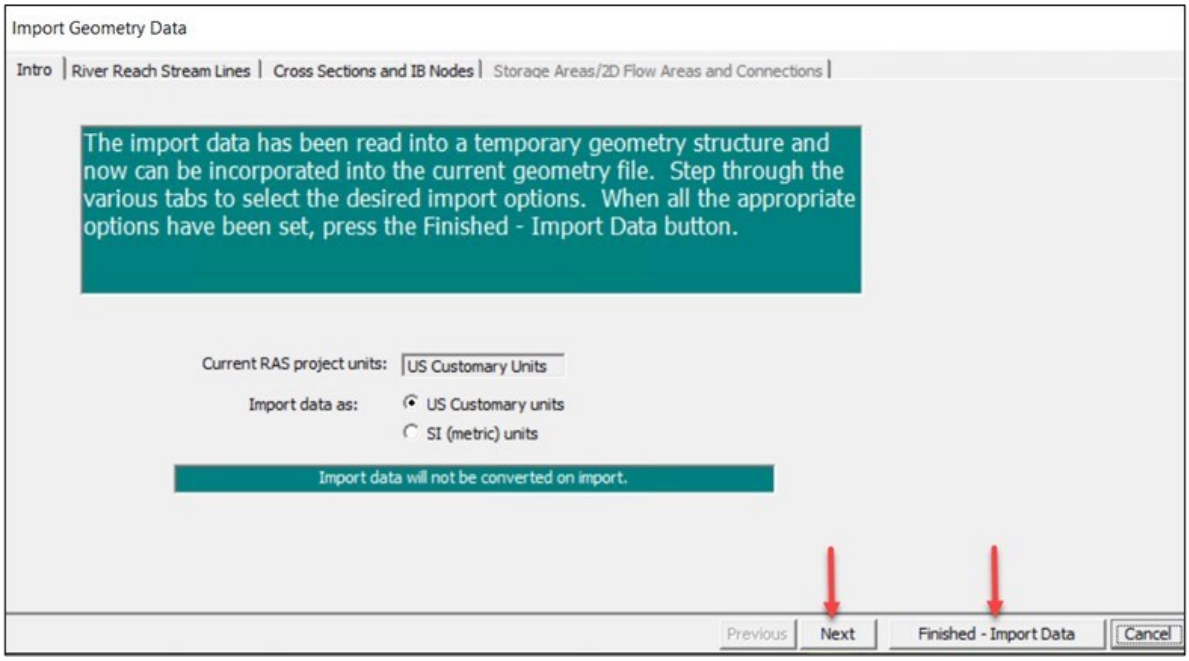

Figure 32

14. In the Geometric Data box, you will see the stream and the cross-section lines from the OpenRoads.geo file.

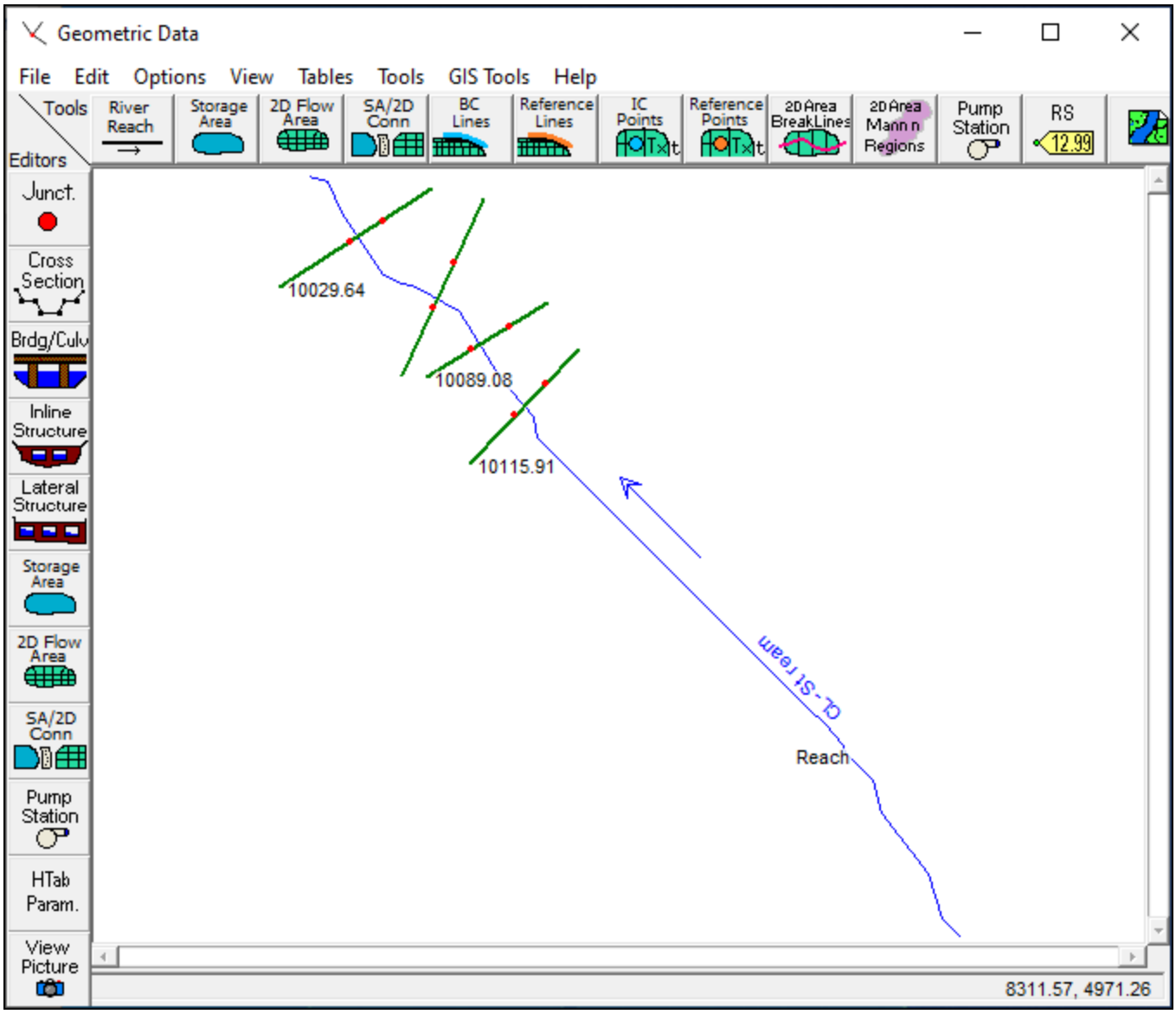

Figure 33

15. Click on the ***Cross-Section*** icon and the Cross Section Data box opens. Work the data as needed.

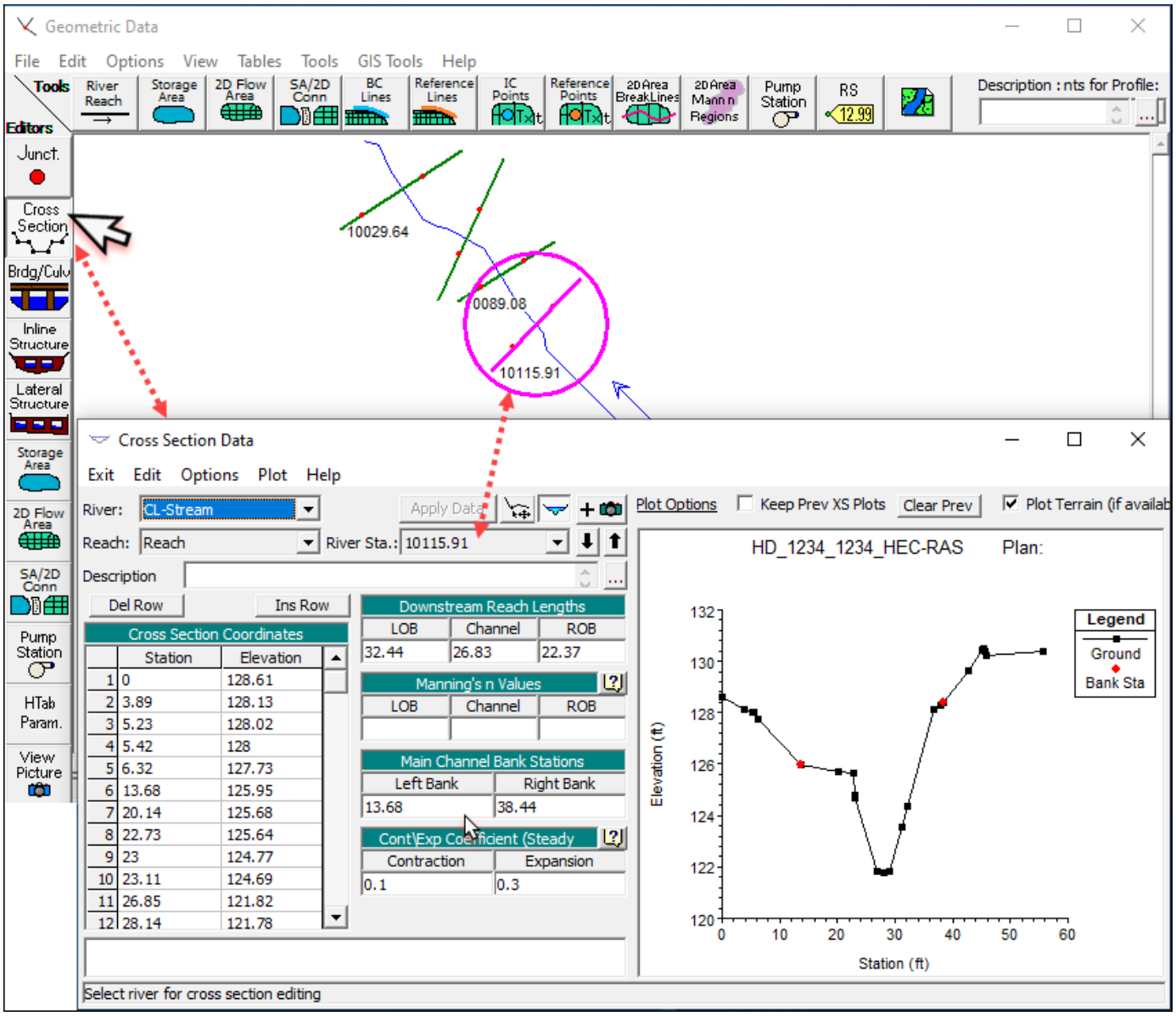
Geometric Data
File Edit Options View Tables Tools GIS Tools Help
Tools
Editors
River Reach
Storage Area
2D Flow Area
SA/2D Conn
BC Lines
Reference Lines
IC Points
Reference Points
2D Area BreakLines
2D Area Mann n Regions
Pump Station
RS
Description : nts for Profile:
Junct.
Cross Section
Brdg/Culv
Inline Structure
Lateral Structure
Storage Area
2D Flow Area
SA/2D Conn
Pump Station
HTab Param.
View Picture
10029.64
10089.08
10115.91
Cross Section Data
Exit Edit Options Plot Help
River: CL-Stream
Reach: Reach
River Sta.: 10115.91
Apply Data
Description
Plot Options
Keep Prev XS Plots
Clear Prev
Plot Terrain (if availab
Del Row
Ins Row
Cross Section Coordinates
Station Elevation
1 0 128.61
2 3.89 128.13
3 5.23 128.02
4 5.42 128
5 6.32 127.73
6 13.68 125.95
7 20.14 125.68
8 22.73 125.64
9 23 124.77
10 23.11 124.69
11 26.85 121.82
12 28.14 121.78
Downstream Reach Lengths
LOB Channel ROB
32.44 26.83 22.37
Manning's n Values
LOB Channel ROB
Main Channel Bank Stations
Left Bank Right Bank
13.68 38.44
Cont\Exp Coefficient (Steady
Contraction Expansion
0.1 0.3
HD_1234_1234_HEC-RAS Plan:
Legend
Ground
Bank Sta
Elevation (ft)
Station (ft)
132
130
128
126
124
122
120
0
10
20
30
40
50
60
Select river for cross section editing

Figure 34

Exercise 2 - Location Plans

COMING SOON

Exercise 3 – Permit Plates

COMING SOON

Revisions